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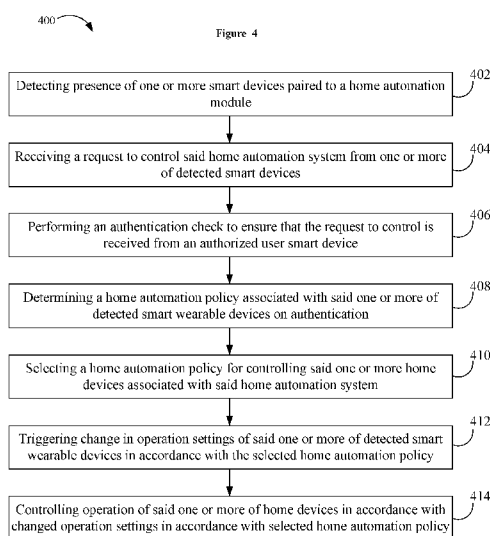
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(54) Title: HOME AUTOMATION SYSTEM



(57) Abstract: The present invention provides a home automation system and a method of operating thereof. The method includes the steps of: detecting presence of one or more smart devices paired to a home automation module; receiving a request to control said home automation system from one or more of detected smart devices; performing an authentication check to ensure that the request to control is received from an authorized user smart device; determining a home automation policy associated with said one or more of detected smart wearable devices upon authentication, wherein said home automation policy is configured to control one or more home devices associated with said home automation system; selecting a home automation policy for controlling said one or more home devices associated with said home automation system triggering change in operation settings of said one or more of home devices in accordance with the selected home automation policy.

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HOME AUTOMATION SYSTEM

FIELD OF THE INVENTION

The present invention relates generally to smart environments. In particular, this pre-set invention relates to automation systems and methods that are configured to automatically and/or remotely control products, devices and appliances in a house or other residential or commercial building.

BACKGROUND OF THE INVENTION

Home automation involves controlling various devices or systems that can be present in homes. Home automation technologies can allow for local and/or remote control of home automation devices. Typically, home automation may include remote and centralized control of lighting, HVAC (heating, ventilation and air conditioning), appliances, security locks of gates and doors and other systems, to provide improved convenience, comfort, energy efficiency and security. The popularity of home automation has been increasing greatly in recent years due to much higher affordability and simplicity through smart phone and tablet connectivity. The concept of the Internet of Things (IOT) has tied in closely with the popularization of home automation. The Internet of Things (IOT) is the network of physical objects or “things” embedded with electronics, software, sensors and connectivity to enable it to achieve greater value and service by exchanging data with the manufacturer, operator and/or other connected devices. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure.

As society advances, households within the society may become increasingly diverse, having varied household norms, procedures, and rules. Unfortunately, because so-called smart devices have traditionally been designed with pre-determined tasks and/or functionalities, comparatively fewer advances have been made regarding using these devices in diverse or evolving households or in the context of diverse or evolving household norms, procedures, and rules. Accordingly, there is still a need for improved and advanced home automation systems, methods, and technologies.

SUMMARY OF THE INVENTION

In an embodiment, a method of operating a home automation system is provided. The method includes the steps of: detecting presence of one or more smart devices paired to a home automation module; receiving a request to control said home automation system from one or more of detected smart devices; performing an

authentication check to ensure that the request to control is received from an authorized user smart device; determining a home automation policy associated with said one or more of detected smart wearable devices on authentication, wherein said home automation policy is configured to control one or more home devices associated with said home automation system; selecting a home automation policy for controlling said one or more home devices associated with said home automation system triggering change in operation settings of said one or more of home devices in accordance with the selected home automation policy; and controlling operation of said one or more of home devices in accordance with changed operation settings in accordance with selected home automation policy.

In another embodiment, a home automation system is provided. The home automation system includes a detecting unit configured for detecting presence of one or more smart devices paired to a home automation module; a receiving unit configured for receiving a request to control said home automation system from one or more of detected smart devices; a processing unit configured for authenticating the user and determining a home automation policy associated with said one or more of detected smart wearable devices, wherein said home automation policy is configured to control one or more home devices associated with said home automation system; a selecting unit configured for selecting a home automation policy stored in a home automation policy module for controlling said one or more home devices associated with said home automation system; a triggering unit configured for triggering change in operation settings of said one or more of home devices in accordance with the selected home automation policy; and a controlling unit configured for controlling operation of said one or more of home devices in accordance with changed operation settings in accordance with selected home automation policy.

It is object of the invention to provide a home automation system that controls the home devices based on the profile of user.

It is another object of the invention to provide a home automation system that provides the user with one or more recommendations in the event of occurrence of unwanted situation.

To further clarify advantages and features of the present invention, a more particular description of the invention will be rendered by reference to specific embodiments thereof, which is illustrated in the appended drawings. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore

not to be considered limiting of its scope. The invention will be described and explained with additional specificity and detail with the accompanying drawings.

BRIEF DESCRIPTION OF FIGURES

These and other features, aspects, and advantages of the present invention will
5 become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

Figure 1 illustrates a block diagram of a system level environment in accordance with an embodiment of the present invention;

10 **Figure 2** illustrates an exemplary of connection of plurality of smart wearable devices with home automation module;

Figures 3A, 3B and 3C illustrate an exemplary combination of connections between the smart wearable devices and the home automation module;

15 **Figure 4** illustrates a flowchart for a method of operating a home automation system in accordance with an embodiment of the present invention;

Figure 5 illustrates a block diagram of a home automation system in accordance with an embodiment of the present invention;

Figure 6 illustrates a block diagram of home automation module in accordance with an embodiment of the present invention;

20 **Figure 7** illustrates a block diagram of communication module in accordance with an embodiment of the present invention;

Figure 8 illustrates a block diagram of an exemplary sensor module in accordance with an embodiment of the present invention;

25 **Figure 9** illustrates a block diagram of exemplary systems controlled by the home automation module in accordance with an embodiment of present invention;

Figure 10 illustrates a block diagram of exemplary set of IoT components/ home devices connected to the home automation module in accordance with an embodiment of present invention;

30 **Figure 11** illustrates a flow chart of the configuration process of the home automation module in accordance with an embodiment of the present invention;

Figure 12 illustrates a flowchart of an exemplary home automation policy execution process in accordance with embodiment of the present invention;

Figure 13 illustrates a flow chart of an exemplary implementation process of home automation policy, when one or more users are found in the location in accordance with embodiment of the present invention;

Figure 14 illustrates a flow chart for a method of providing recommendation to user of a home automation system in accordance with an embodiment of the present invention; and

Figure 15 illustrates a flow chart of a method of providing one or more recommendations to user of a home automation system in accordance with another embodiment of the present invention.

Further, skilled artisans will appreciate that elements in the drawings are illustrated for simplicity and may not have been necessarily been drawn to scale. For example, the flow charts illustrate the method in terms of the most prominent steps involved to help to improve understanding of aspects of the present invention. Furthermore, in terms of the construction of the device, one or more components of the device may have been represented in the drawings by conventional symbols, and the drawings may show only those specific details that are pertinent to understanding the embodiments of the present invention so as not to obscure the drawings with details that will be readily apparent to those of ordinary skill in the art having benefit of the description herein.

DETAILED DESCRIPTION:

For the purpose of promoting an understanding of the principles of the invention, reference will now be made to the embodiment illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated system, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

It will be understood by those skilled in the art that the foregoing general description and the following detailed description are exemplary and explanatory of the invention and are not intended to be restrictive thereof.

Reference throughout this specification to “an aspect”, “another aspect” or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrase “in an embodiment”, “in another

embodiment” and similar language throughout this specification may, but do not necessarily, all refer to the same embodiment.

The terms "comprises", "comprising", or any other variations thereof, are intended to cover a non-exclusive inclusion, such that a process or method that
5 comprises a list of steps does not include only those steps but may include other steps not expressly listed or inherent to such process or method. Similarly, one or more devices or sub-systems or elements or structures or components preceded by "comprises...a" does not, without more constraints, preclude the existence of other
10 devices or other sub-systems or other elements or other structures or other components or additional devices or additional sub-systems or additional elements or additional structures or additional components.

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. The system, methods, and examples provided herein are illustrative
15 only and not intended to be limiting.

Embodiments of the present invention will be described below in detail with reference to the accompanying drawings.

Figure 1 illustrates a block diagram of system level environment in accordance with an embodiment of the present invention. The system 100 includes a plurality of
20 smart wearable devices 102, a mobile device 104, a home automation module 106, an application server 108 and a database 110. The smart wearable device 102 may be any smart device which is capable of sending commands, instructions to the application server 108 and the home automation module 106. The smart wearable device 102 may include, but not limited, to a smart watch, smart fitness bands, smart shoes, smart glass,
25 smart earphones/ headphones, smart clothing, smart jewellery to name a few. As shown there, a smart wearable device 102 of a first user is directly connected to the home automation module 106. Further, the smart wearable device 106 is connected directly to the application server 108 or either through a mobile device 104 (a mobile application is configured in the mobile device 104, which can receive inputs from smart wearable
30 device 102, home automation module 106 and the application server 108). In another embodiment, the settings/configurations for the home automation module 106 are performed through the mobile application (configured in the mobile device 104). In yet another embodiment, the smart wearable devices 102 can be paired with the home automation module 106. In yet another embodiment, the mobile device 104 of the user is

also paired with the home automation module 106. The application server 108 processes the data relating to the smart wearable device 102, mobile device 104 and home automation module 106. The database 110 stores the details of user profiles, and home automation module 106 configuration details. In another embodiment, the settings of home automation module 106 are shared and updated in the database 110 through the application server 108. In an embodiment, the home automation module 106 is capable of monitoring plurality of IoT components (connected, interconnected) in the home. The home automation module 106 further process instructions received from the smart wearable device 106 and the application server 108. In addition, the home automation module 106 also automatically schedules the activity to be performed by the IoT components based on the settings pre-configured by the user.

Figure 2 illustrates an exemplary of connection of plurality of smart wearable devices with home automation module. Each of the smart wearable device 102₂, 102₄, 102₆...102_n is paired with the home automation module 106 and the home automation module 106 is capable of identifying the smart wearable device 102₂, 102₄, 102₆...102_n in real-time and also capable of switching between user configuration settings.

Figures 3A, 3B and 3C illustrate an exemplary combination of connections between the smart wearable devices and the home automation module. The home automation module 106 stores profiles of user. Figure 3A illustrate combination of one smart wearable device 102₂ paired with the home automation module 106. Figure 3B illustrate combination of two smart wearable devices 102₂ and 102₄ paired with the home automation module 106. Figure 3C illustrate combination of three smart wearable devices 102₂, 102₄, and 102₆ paired with the home automation module 106. The home automation module 106 is configured to receive commands from smart wearable devices 102₂, 102₄, 102₆. The profiles of user further comprise, the smart wearable device Unique identification number (UIN), name, wearable type, configurations, commands/instructions to be performed for scheduled activities, total active duration of profile, list of all IoT components connected with home automation module, accessible list of IoT components, threshold values for each IoT component, condition of each IoT component (active/idle) etc. In an embodiment, a single user can have multiple profiles (configuration settings for connected IoT components) in the home automation module. In another embodiment, the user may select a profile (from the list of profiles) to be exhibited by the home automation module. In another embodiment, each user may have a default profile. The profiles are specific in nature and vary between user to user. The

home automation module 106 is pre-programmed to accept and execute the instructions based on the profile data.

Referring to **Figure 4**, a flowchart for a method of operating a home automation system in accordance with an embodiment of the present invention is illustrated. The method 400 includes the step 402 of detecting presence of one or more smart devices paired to a home automation module. A request to control the home automation system is received from one or more of detected smart wearable devices in step 404. Once the request is received from one or more of detected smart wearable devices in step 404, the method 400 performs an authentication check in step 406 to ensure that the request to control is received from an authorized user device. In an exemplary implementation, the authentication check may involve matching a unique id contained in the request for controlling the home automation system with pre-configured unique ids. During configuration of home automation module, a unique id is configured for each user. In an implementation, the unique id may be same for all the smart wearable devices belonging to the same user. In an implementation, each smart wearable device may contain different unique ids but linked to a single user. In another exemplary implementation, the authorization check involves sending and matching a unique randomly generated onetime password to the registered mobile number associated with one or more detected mobile devices. In case the user is not authenticated, the request is declined. Once the user is authenticated a home automation policy associated with said one or more of detected smart wearable devices is determined in step 408, wherein said home automation policy is configured to control one or more home devices associated with said home automation system. Thereafter, the home automation policy is selected in step 408 for controlling said one or more home devices associated with said home automation system. The appropriate selection of the home automation policy triggers change in operation settings of said one or more of detected smart wearable devices in accordance with the selected home automation policy in step 412. The operation settings include settings relating to temperature, power, speed, mode, intensity level and other operations associated with said home devices. For instance, settings associated with speed of fan, setting associated with intensity level of lights, opening/ closing of home equipment such as curtains, doors, gates, windows etc. etc. The operation of said one or more of home devices is then controlled in accordance with changed operation settings in accordance with selected home automation policy in step 414.

In an embodiment, selecting a home automation policy for controlling said one or more devices associated with said home automation system includes selecting the home automation policy in accordance with pre-defined priority levels associated with said one or more smart devices.

5 In another embodiment, the method 400 includes receiving a request to control said home automation system from at least two smart devices simultaneously. In such a case, a common household policy is computed, wherein said common household policy is based on profile of users associated at least two smart devices and includes operation settings compatible to said at least two smart devices.

10 In another embodiment, the triggering change in operation settings of said one or more home devices includes one or more of: switching the operation settings associated with default home automation policy to selected home automation policy; or switching the operation settings associated with home automation policy associated with a first smart device to home automation policy associated with a second smart device.

15 In another embodiment, the method 400 includes detecting a location of said one or more of detected smart devices; selecting a household policy based on detected location. The location may be inside the home premises or within pre-defined area outside the home premises. In an implementation, different intra-home automation policies may also be defined. For instance, a different home automation policy may be defined when a user is in Room A and a home automation policy may be defined when
20 the same user is in Room B. In another embodiment, the household policy may automatically be selected when the user's location is found to be in a pre-defined distance from the home automation system.

 In another embodiment, the method 400 includes monitoring said one or more
25 smart devices; notifying the user in the event of: occurrence of abnormal operation of said one or more smart devices, data values pertaining to said one or more smart devices reaches pre-defined threshold; and recommending user with one or more action items to be taken in the event of occurrence of abnormal operation of said one or more smart devices or data values pertaining to said one or more smart devices reaches pre-defined
30 threshold. The recommendations with respect to one or more action items to be taken may be based on the type of one or more home device, location of user, pre-stored profile of user. The one or more recommendations may include, but not limited to, reminder for getting the home device serviced on crossing a service threshold time period or wear and tear of any part of home device, reminder for purchase of any

required product/ item in the even any particular home device (item) goes below threshold.

In another embodiment, the method 400 further includes monitoring one or more environmental parameters relating to temperature, humidity, moisture content, light
5 intensity surrounding said one or more devices; modifying operation settings associated with said one or more devices based on said monitoring; and notifying user of the modification made to the operation settings associated with said one or more devices.

In another embodiment, the triggering of change in operation settings of said one or more of home devices includes one or more of: switching the operation settings
10 associated with default home automation policy to selected home automation policy; or switching the operation settings associated with home automation policy associated with a first smart device to home automation policy associated with a second smart device.

In an implementation, one or more home devices require a pre-authentication check for access. The present invention involves suitable encryption techniques for
15 performing the authentication checks. In an embodiment, the method 400 includes ascertaining of one or more particular home devices to be controlled by the user smart device require a unique authentication code for access. On positive ascertaining, the unique authentication code is requested from the one or more smart wearable devices and an authentication check is performed by matching the unique authentication code as
20 received by the smart wearable device with a pre-configured unique code required to access one or more particular home devices. On authentication, the access to control the one or more home devices is provided. In an example, if a request is made to access a personal locker or safe having valuable items, a unique id as set and pre-configured by the user of the locker is sent to the smart wearable device requesting the access of the
25 locker. In case the unique id as received from the smart wearable device matches with the unique id set by the user during the configuration stage, the access would be provided else the access would be declined.

Referring to **Figure 5**, a block diagram of a home automation system in accordance with an embodiment of the present invention is illustrated. The home
30 automation system 500 includes one or more home devices 502 including home appliances, home lighting, HVAC (heating, ventilation and air conditioning), appliances, security locks of gates and doors and other devices and systems used in home or residential building. The term “home devices” 502 may also intend to cover one or more products such as food items, beverage items, reading items, utensils, apparel items, and

items in connection thereof used by a user. The present invention may not be restricted only to home automation and may cater commercial automation systems or any premises where automation may be needed. The home automation system 500 includes a detecting unit 504 configured for detecting presence of one or more smart devices paired to a

5 home automation policy module 506 (which is home automation module 106 in Figure 1). The detecting unit 504 may include one or more wireless signal sensing devices including but not limited to, Bluetooth sensor, Wi-Fi sensor etc. The home automation system 500 further includes a receiving unit 508 which is configured for receiving a request to control said home automation system 500 from one or more of detected smart

10 devices. A processing unit 510, in operational interconnection with the home automation policy module 506, is configured to perform an authentication check to ensure that the request to control is received from an authorized user device. The processing unit 510 may authenticate the user (or user device) by matching a unique id contained in the request for controlling the home automation system with pre-configured unique ids. In

15 another exemplary implementation, the processing unit 510 may transmit and match a unique randomly generated onetime password to the registered mobile number associated with one or more detected mobile devices. The processing unit 510 on authenticating the user determines a home automation policy associated with said one or more of detected smart wearable devices, wherein said home automation policy is

20 configured to control said one or more home devices 502 associated with said home automation system 500. A selecting unit 512 is further provided for selecting a home automation policy stored in the home automation policy module 506 for controlling said one or more home devices 502 associated with said home automation system 500. The home automation policies are pre-stored in a database 514 and are configurable by the

25 user. The home automation policies for controlling said one or more home devices are selected based on pre-defined priority levels associated with said one or more smart devices, or location of the one or more smart devices or type of smart device. The home automation system 500 further includes a triggering unit 524 that triggers change in operation settings of said one or more of home devices 502 in accordance with the

30 selected home automation policy. The one or more of home devices 502 are controlled by a controlling unit 516 in accordance with changed operation settings in accordance with selected home automation policy.

In another embodiment, the home automation system 500 includes a location determining unit 518 configured to detect location of said one or more of detected smart devices and operate in operational interconnection with the selecting unit 512 to select a household policy based on detected location. The home automation system 500 further includes one or more sensors 520 for monitoring one or more environmental parameters relating to temperature, humidity, moisture content, light intensity surrounding said one or more devices. The sensors 520 may also include weighing sensors to measure weight of any home product. The home automation system 500 further includes a recommendation unit 522 that is configured to send an alert or recommendation on detecting unwanted event with one or more home devices.

Figure 6 illustrates a block diagram of home automation module in accordance with an embodiment of the present invention. The home automation module 106 comprises a micro controller 602, a communication module 604, a sensor module 606 and a memory 608. The communication module 602 is capable of sending suitable signals to the nearby smart wearable devices 102. In an embodiment, the communication module 604 is responsible for establishing the real-time secure connection between the user and the home automation module 106. The communication module 604 employs various security protocols to authenticate the user. The communication module 604 is connected to all the IoT devices/ components 610 in the home. The sensor module 606 may comprise various sensor circuits deployed in the home, which may be capable of monitoring and detecting the real-time values of the parameters. The micro controller 602 is capable of analyzing any data from communication module 604, memory 608 and sensor module 606. The memory 608 is capable of storing the profile data, stress levels of user, instructions/commands relating to the profiles, threshold values of all IoT components 610, threshold values of all sensor modules 606, data relating to communication module 604 (connection/disconnection data, number of devices connected, location information of user determined through GPS) etc.

Figure 7 illustrates a block diagram of communication module in accordance with an embodiment of the present invention. The communication module 604 includes, but not limited to, an IR module 702, a Wi-Fi module 704, a relay circuit 706, and a Bluetooth module 708 (internal modules). The communication module 604 may propagate and receive signals in any one or all of the internal modules. The relay circuit 706 of communication module 604 controls the electrical system 710 of the home.

Figure 8 illustrates a block diagram of an exemplary sensor module in accordance with an embodiment of the present invention. The sensor module 606 includes, but not limited to, temperature/humidity sensor 802, light sensor 804, motion sensor 806, smoke sensor 808, door sensor 810, a synthetic sensor 812, an IR sensor 814,
5 a proximity sensor 816 and weighing sensor 818.

Figure 9 illustrates a block diagram of exemplary systems controlled by the home automation module in accordance with an embodiment of present invention. The home automation module 106 controls the home electrical system 902, home entertainment system 904, home security system 906, home water flow system 908,
10 home accessories system 910 (including furniture, or anything which can be moved from one position to another position).

Figure 10 illustrates a block diagram of exemplary set of IoT components/ home devices connected to the home automation module in accordance with an embodiment of present invention. The IoT components 608 include, but not limited to, television 1002,
15 AC 1004, washing machine 1006, coffee maker 1008, fridge 1010, microwave oven 1012, any electronic equipment 1014 (for example, iron box, geyser), and other electrically/electronically operated appliances 1016 in home.

Figure 11 illustrates a flow chart of the configuration process of the home automation module in accordance with an embodiment of the present invention. The process 1100 starts at step 1102 where the home automation module receives a first communication signal from a first device. The communication signal may contain a connection or a pairing request. The first device may be a smart wearable device or a mobile device. In an embodiment, the first device is a mobile device and is used to configure the settings of the home automation module. In another embodiment, a smart
20 wearable device is paired with the mobile device and is capable of operating and controlling the home automation module. In an embodiment, both smart wearable device and mobile device contain a GPS module to share the location (of the user) in real-time. Further, the mobile application configured in the mobile device is capable of monitoring the connected smart wearable device. In step 1104, the home automation module and
25 smart wearable device are paired. In an embodiment, the mobile device of the user is also paired with the home automation module. In yet another embodiment, the smart wearable itself is capable of configuring the home automation module through a display unit. In step 1106, the home automation module receives set of instructions/configuration parameters from the user controlled smart wearable. In step 1108, the home automation
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module suggests suitable threshold values for the configuration made by the user. The sensor module of home automation module shall be having all real-time values/threshold values relating to sensor modules. Further, the home automation module allows the user to create a customized set of values for each of the connected IoT component. In step 5 1110, the user decides, configures and sets instructions for the home automation module. In step 1112, the home automation module initiates the process of monitoring all connected IoT components in and around the house.

Figure 12 illustrates a flowchart of an exemplary home automation policy execution process in accordance with embodiment of the present invention. The execution process 1200 starts at step 1202. In step 1202, the home automation module 10 sends signals to identify and find proximity of devices. Usually, the subject module searches for the paired smart wearable device to perform at least one task associated to the IoT components. In step 1204, the home automation module receives an acknowledgement from a smart wearable device and further, fetches and analyzes the 15 details of identified smart wearable devices and its associated profile. In step 1206, the home automation module verifies whether the detected device is first device (first user's smart wearable), If yes, the control is transferred to step 1208, otherwise the control is transferred to step 1212. In step 1208, the home automation module recognizes the first user and retrieves the first set of instructions (from the first user profile) to be shared 20 with the IoT components. Further, in step 1210, the home automation module processes the first set of instructions and controls the operations of IoT components. In step 1212, the home automation module verifies whether the detected device is second device (second user's smart wearable device). If yes, the control is transferred to step 1214, otherwise the control is transferred to step 1218. In step 1214, the home automation module 25 recognizes the second user and retrieve the second set of instructions (from the second user profile) to be shared with IoT components. Further, in step 1216, the home automation module processes the second set of instructions and controls the operations of IoT components.

In step 1218, the home automation module finds whether one or more paired 30 devices (first, second, third or any other user's smart wearable) are in its range. If yes, the control is transferred to step 1220, otherwise the control is transferred to step 1224. In step 1220, the home automation module recognizes the one or more users are present in the home and retrieve the third set of instructions (a comparative analysis is performed between the configuration settings of one or more users currently in home, and an

optimal configuration setting is determined [for all IoT components, considering all sensor values] and suitable instructions are fetched) to be shared with IoT components. Further, in step 1222, the home automation module processes the third set of instructions and controls the operations of IoT components. In step 1224, the home automation system could not able to process the device analysis.

Figure 13 illustrates a flow chart of an exemplary implementation process of home automation policy, when one or more users are found in the location. The implementation process 1300 starts in step 1302. In step 1302, the home automation module receives one or more signals from one of more connected/paired devices (smart wearable devices). In step 1304, the home automation module analyzes the configuration settings of all devices which are in range. Further, the subject module fetches the profile data and prepares the data for comparison. In step 1306, upon comparison, the home automation module checks whether any priority is being set, when one or more users in same location (for example, priority among users). If yes, the control is transferred to step 1308, otherwise the control is transferred to step 1312. In step 1308, the subject module recognizes the priority and retrieves set of instructions related to the first priority profile data (user data). Further, in step 1310, the home automation module processes a set of instructions and controls the operations of IoT components. In step 1312, the home automation module checks whether the users are equally frequent to the location of home (the home has different rooms, the frequency of visiting a room or being in a room). If yes, the control is transferred to step 1314, otherwise the control is transferred to step 1318. In step 1314, the subject module recognizes the most frequent user and retrieves set of instructions related to that user who is more frequent. Further, in step 1316, the home automation module processes the set of instructions relating to the frequent user and controls the operations of IoT components. In step 1318, the home automation module compares the configuration settings of all users through the profile data. In step 1320, home automation module computes an optimal configuration setting (for all IoT components) which is compatible to all users and based on the user profile data. In step 1322, the home automation module retrieves the set of instructions (relating to optimal configuration settings) to be executed, from memory. In step 1324, the home automation module processes the set of instructions relating to optimal configuration and controls the operations of IoT components.

Figure 14 illustrates a flow chart for a method of providing recommendation to user of a home automation system in accordance with an embodiment of the present invention. The method 1400 includes step 1402 of receiving data values captured by one or more sensors connected with one or more household items and household devices. Thereafter, the data values captured by said one or more sensors are compared with pre-stored corresponding threshold values in step 1404 and the user is alerted in step 1406 if a variation, as a result of comparison, between data values captured by said one or more sensors and pre-stored corresponding threshold values is found to be beyond acceptable range. The alert may be sent to the user mobile's device or smart wearable device and may be sent in the form of email, SMS, flash message, MMS or a voice call. Thereafter, the current geographic location of the user is determined in step 1408 and one or more recommendations and actionable items are ascertained in step 1410 based on the current location of the user and comparison made between data values captured by said one or more sensors and pre-stored corresponding threshold values, wherein said recommendations and actionable items are provided in context of said one or more household items and household devices. The one or more recommendations and actionable items are recommended to the user in step 1412.

In exemplary implementation of the present invention in context of method described in Figure 14, a container module is considered to be an IoT device (for example, a kitchen cabinet) which is connected to the home automation system. The container module may include a controller unit, a power unit, a communication module and a sensor unit. The kitchen containers are placed in a container module. The kitchen containers may be used to store rice, cereals and other perishable items. The sensors such as force sensor and a weight sensor, are being used to determine the rate of change of quantity of items which are being stored in a kitchen container. An alert is sent to home automation system, whenever, the quantity of the items (which are stored in the containers), goes below a threshold value, set either by the system itself or by the user. In another embodiment, the user can configure the threshold value for each kitchen container connected to the container module. In one example, the container module is a rectangular cabinet, which can accommodate variety of small, medium containers. Further, one or more sensors can be used to determine the quantity of item stored in the container. In an embodiment, a dedicated set of sensors may be used for each container to individually receive the sensor data (of subject one container). The sensor units are interconnected and a comprehensive set of sensor data values are forwarded to the

controller unit of container module for further processing. The threshold values for each container may vary and user can set the value for every container (for example, minimum quantity to operate, the item 'RICE' should be minimum 5KG, if the value of RICE container is going below 5KG, notify and remind the user to purchase RICE).

5 In an embodiment, the home automation system continuously keeps a track of the current location of the user. The home automation system being connected with the internet (through a secure encrypted connection) is configured to locate nearby shops/provision store/malls etc. In another embodiment, considering the alert received from the container module, the home automation system sends appropriate
10 suggestions/notifications to the user, to purchase the items which are below the threshold value, even though the user has not gone out with intention of purchasing any items or shopping. For example, the user visits to a place (11th main, Jayanagar), the home automation system knows the above location of the user. Further, the home automation system has the data of items which are below the threshold level (list of items to
15 purchased). The system shall immediately send a notification to the user with a message "Rice is low in stock, there is a Venkateshwara Rice shop near to your place, which is only 50m from your location, please purchase RICE". In an embodiment, the home automation system will send notification to the user, only when the user is found within the range (preconfigured value, set by user himself) of stores/malls. In an embodiment,
20 the home automation system also comprises a reminder module. The user may further provided with options to store any reminders in the reminder module. The input for reminder module is either through voice signal or App data (the reminders set by the user in the application, will get updated to the reminder module in real-time).

Referring to **Figure 15**, a flow chart of a method of providing one or more
25 recommendations to user of a home automation system in accordance with another embodiment of the present invention is illustrated. The method 1500 includes step 1502 of analyzing profile of said user and step 1504 of ascertaining one or more upcoming actionable items based on the user's profile. Based on the analysis of user's profile, details of one or more upcoming actionable items are alerted to the user in step 1506.
30 Thereafter, current geographic location of the user is determined in step 1508 and one or more recommendations in context of said one or more actionable items are provided to the user in step 1510, wherein said one or more recommendations are based on current geographic location of the user and said one or more recommendations assist in meeting said one or more upcoming actionable items.

In exemplary implementation of the present invention in context of method described in Figure 15, the home automation system maintains the profile data of all users in the home. The system analyzes the data in the user's profile and compares with the current value. Considering the first operation, if the current value is matching with the threshold value, then the system will notify/remind the user, to perform at least one related task with respect to the operation. For example, the user in at office, his daughter's birthday is in two days. The system knows the current location of the user (that, he is in office) and it also knows the birth date of user's daughter (configured in the user profile). The user would like to present a gift to his child. The system further knows, the location of shops (example, textile shops, cloth shop) near to user's current location with a sale details. The sale details include, details of cloth with its rate, offer details etc. The system will suggest plurality of shops which are in the range of the user. In one example, the system also suggests the most suitable dress for his daughter (based on user's preferences stored in his daughter's profile) and where to purchase that dress, availability of such dress etc.

The drawings and the forgoing description give examples of embodiments. Those skilled in the art will appreciate that one or more of the described elements may well be combined into a single functional element. Alternatively, certain elements may be split into multiple functional elements. Elements from one embodiment may be added to another embodiment. For example, orders of processes described herein may be changed and are not limited to the manner described herein. Moreover, the actions of any flow diagram need not be implemented in the order shown; nor do all of the acts necessarily need to be performed. Also, those acts that are not dependent on other acts may be performed in parallel with the other acts. The scope of embodiments is by no means limited by these specific examples. Numerous variations, whether explicitly given in the specification or not, such as differences in structure, dimension, and use of material, are possible. Benefits, other advantages, and solutions to problems have been described above with regard to specific embodiments.

Claims

We claim,

1. A method of operating a home automation system, the method comprising:
 - detecting presence of one or more smart devices paired to the home automation system;
 - receiving a request to control said home automation system from one or more detected smart devices;
 - performing an authentication check to ensure that the request to control is received from an authorized smart device;
 - determining a home automation policy for each of the one or more of detected smart devices on authentication, wherein said home automation policy comprises a plurality of instructions to control one or more home devices associated with said home automation system;
 - selecting at least one home automation policy based on said determining, wherein selected at least one home automation policy is configured to trigger a change in operation and control settings of said one or more of home devices; and
 - controlling operation of said one or more of home devices in accordance with changed operation settings in accordance with selected home automation policy.
2. The method as claimed in claim 1, further comprising:
 - associating a first smart device from said one or more smart devices to a first user;
 - configuring at least one application within the first smart device; and
 - controlling operation of said one or more of home devices using the at least one application.
3. The method as claimed in claim 2, further comprising:
 - generating a plurality of profiles of the first user, wherein each profile has a corresponding operational setting for the one or more home devices;
 - selecting at least one profile from the plurality of profiles of the first user; and
 - updating the home automation policy in accordance with the selected profile of the first user.

4. The method as claimed in claim 1, wherein performing an authentication check comprises:
 - sending and matching a unique randomly generated onetime password to a registered mobile number associated with one or more detected smart devices; and
 - declining the request on account of failure in the authentication check.
5. The method as claimed in claim 1, further comprising:
 - defining a priority hierarchy list comprising the one or more detected smart devices; and
 - selecting the at least one home automation policy as per a priority level of the one or more detected smart devices in the priority hierarchy list.
6. The method as claimed in claim 1, further comprising:
 - determining a first home automation policy for a first detected smart device and a second home automation policy for a second detected smart device respectively, wherein the first smart device is associated with a first user and a second device is associated with a second user;
 - defining a new home automation policy using the first home automation policy and the second home automation policy; and
 - controlling operation of said one or more of home devices in accordance with the common home automation policy.
7. The method as claimed in claim 6, further comprising:
 - determining priorities associated with the first user and the second user; and
 - selecting the first home automation policy when the priority of the first user is greater than the priority of the second user.
8. The method as claimed in claim 1, wherein the triggering change in operation settings of said one or more home devices comprises one or more of:
 - switching the operation settings associated with default home automation policy to the selected home automation policy; and
 - switching the operation settings associated with home automation policy associated with a first smart device to operation settings associated with home automation policy associated with a second smart device.

9. The method as claimed in claim 1, further comprising:
 - detecting a location of said one or more of detected smart devices; and
 - selecting a home automation policy based on detected location.
10. The method as claimed in claim 9, further comprising:
 - determining a frequency of the detected first device near a predetermined location;
 - locating the one or more home devices near the predetermined location; and
 - selecting the home automation policy of the one or more home devices located near the predetermined location in accordance with the home automation policy associated with the first device.
11. The method as claimed in claim 1, further comprising:
 - monitoring said one or more home devices;
 - notifying a user of one or more detected smart devices in event of occurrence of at least one of abnormal operation of said one or more home devices, data values pertaining to said one or more home devices reaching a pre-defined threshold; and
 - recommending the user with one or more action items to be taken in the event of occurrence of abnormal operation of said one or more home devices or data values pertaining to said one or more home devices reaching the pre-defined threshold.
12. The method as claimed in claim 11, further comprising:
 - receiving an input from a user to update the pre-defined threshold values pertaining to said one or more home devices.
13. The method as claimed in claim 1, further comprising:
 - monitoring one or more environmental parameters surrounding said one or more home devices;
 - modifying operation settings associated with said one or more home devices based on said monitoring; and
 - notifying user of the modification made to the operation settings associated with said one or more home devices.
14. The method as claimed in claim 1, further comprising:

receiving manual operational setting from a user of the one or more home devices to control the operations of the one or more home devices.

15. A home automation system comprises:

- a detecting unit configured for detecting presence of one or more smart devices paired to the home automation system;

- a receiving unit configured for receiving a request to control said home automation system from one or more detected smart devices;

- a processing unit configured for authenticating one or more detected smart devices and determining a home automation policy associated with said one or more of detected smart wearable devices on authentication, wherein said home automation policy is configured to control one or more home devices associated with said home automation system;

- a selecting unit configured for selecting home automation policy based on said determining, said home automation policy being stored in a home automation policy module and configured for controlling said one or more home devices associated with said home automation system;

- a triggering unit configured for triggering change in operation and control settings of said one or more of home devices in accordance with the selected at least one home automation policy; and

- a controlling unit configured for controlling operation of said one or more of home devices in accordance with changed operation settings in accordance with selected home automation policy.

16. The system as claimed in claim 15, further comprising:

- a profile builder configured to generate a plurality of profiles of the first user, wherein each profile has a corresponding operational setting for the one or more home devices; and wherein the selecting unit is configured to select at least one profile from the plurality of profiles of the first user; and update the home automation policy in accordance with the selected profile of the first user.

17. The system as claimed in claim 15, further comprising:

a priority hierarchy list comprising the one or more detected smart devices; wherein the selecting unit is configured to select the at least one home automation policy as per a priority level of the one or more detected smart devices in the priority hierarchy list.

18. The system as claimed in claim 15, wherein the selecting unit is configured to:

determine a first home automation policy for a first detected smart device and a second home automation policy for a second detected smart device, wherein the first smart device is associated with a first user and a second device is associated with a second user; and

define a common home automation policy using the first home automation policy and the second home automation policy;

control operation of said one or more of home devices in accordance with the common home automation policy.

19. The system as claimed in claim 15, wherein the triggering unit is configured to perform at least one of:

switch the operation settings associated with default home automation policy to selected home automation policy; and

switch the operation settings associated with home automation policy associated with a first smart device to home automation policy associated with a second smart device.

20. The system as claimed in claim 15, further comprising:

a monitoring unit for monitoring said one or more home devices;

a notification engine for notifying a user of one or more detected smart devices in event of occurrence of at least one of abnormal operation of said one or more home devices, data values pertaining to said one or more home devices reaching a pre-defined threshold; and

a recommendation engine for recommending the user with one or more action items to be taken in the event of occurrence of abnormal operation of said one or more home devices or data values pertaining to said one or more home devices reaching pre-defined threshold.

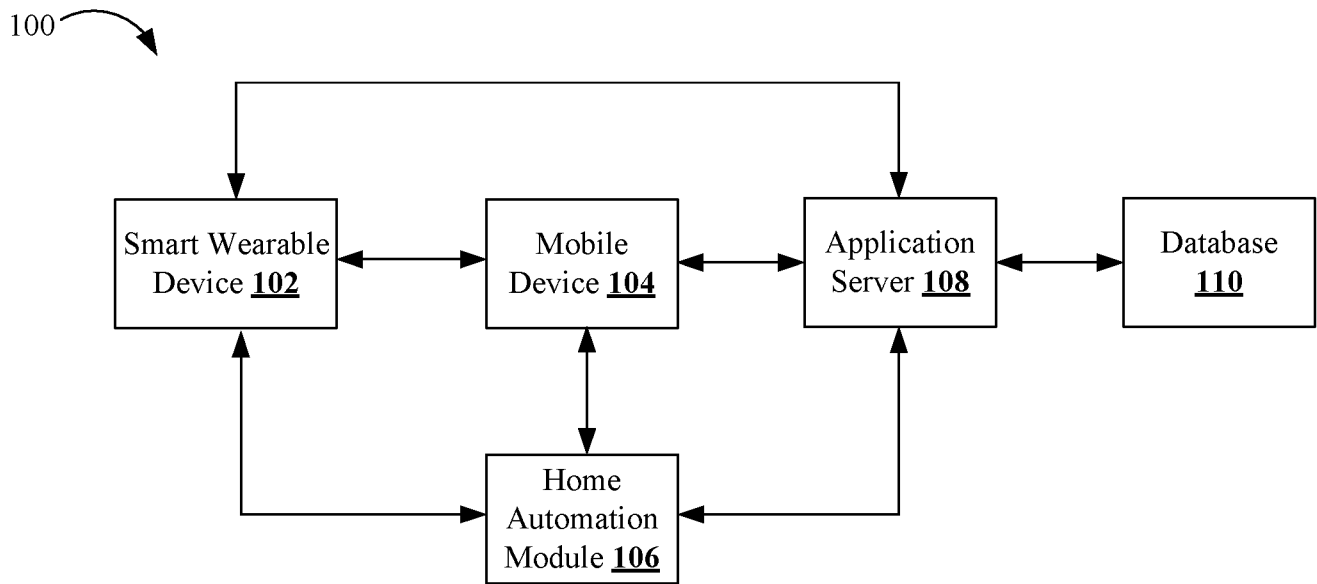


Figure 1

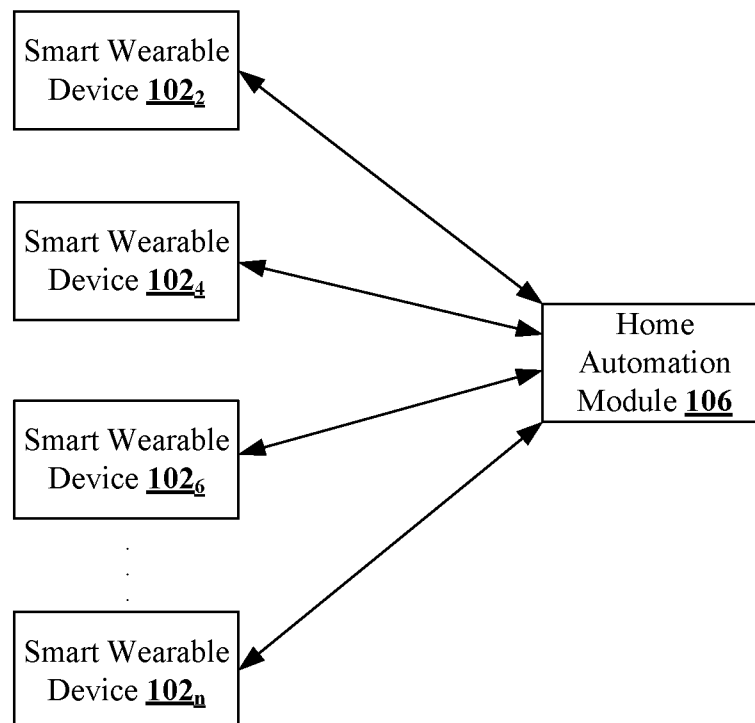


Figure 2

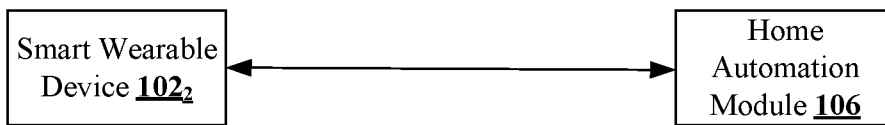


Figure 3A

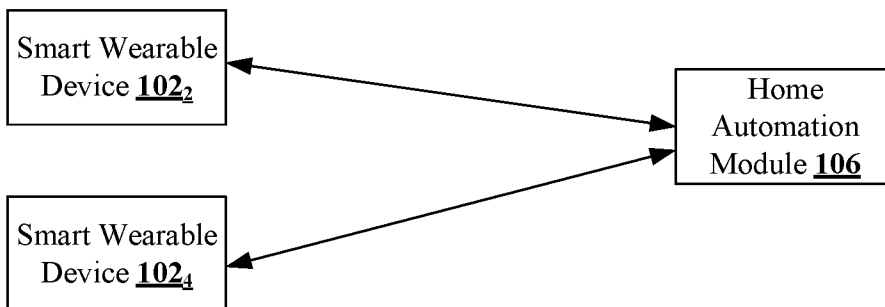


Figure 3B

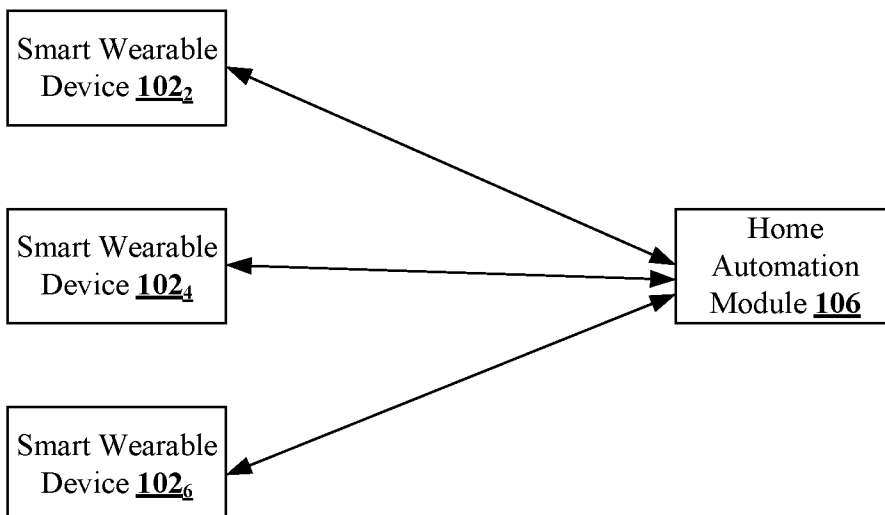


Figure 3C

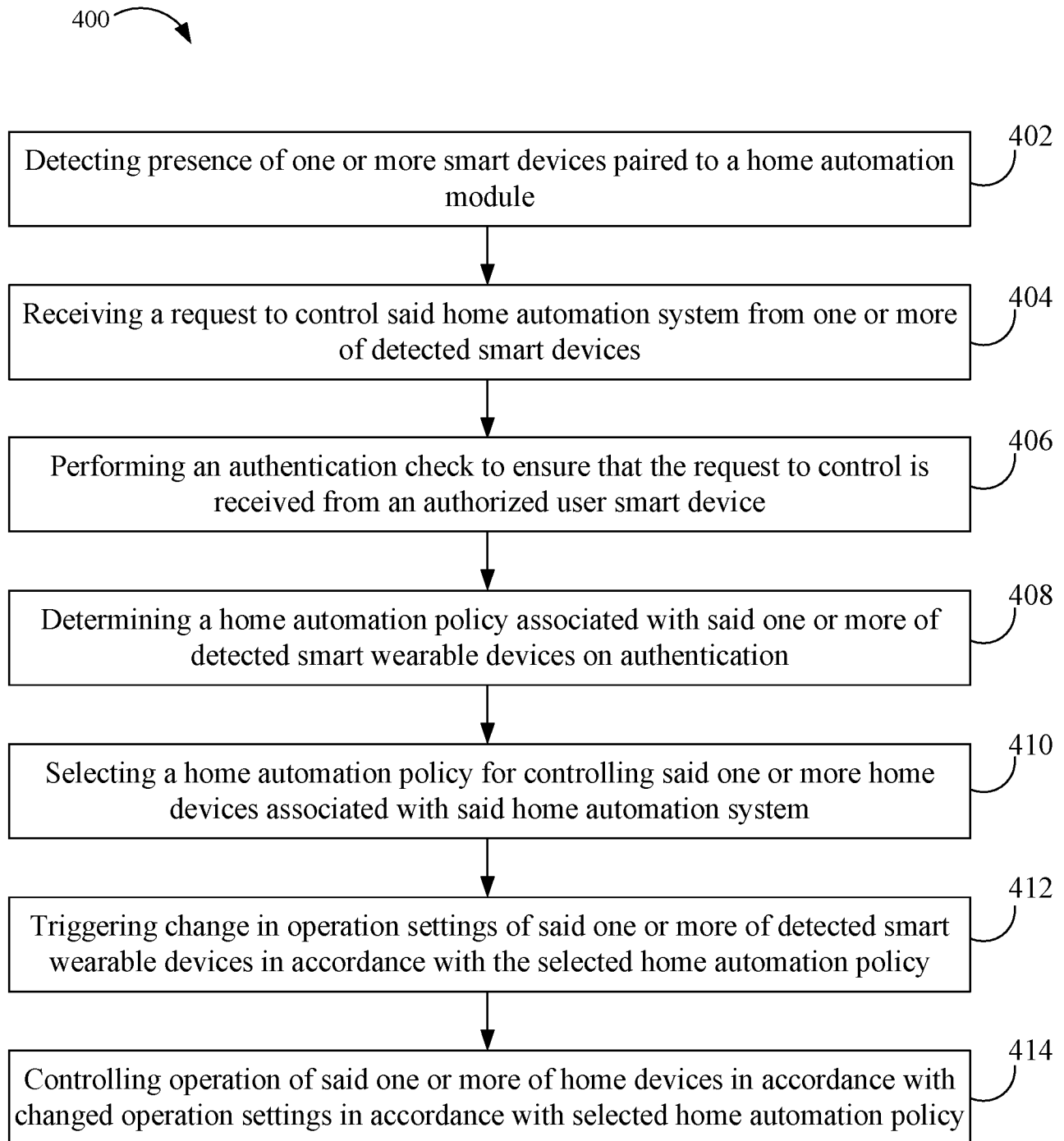


Figure 4

500

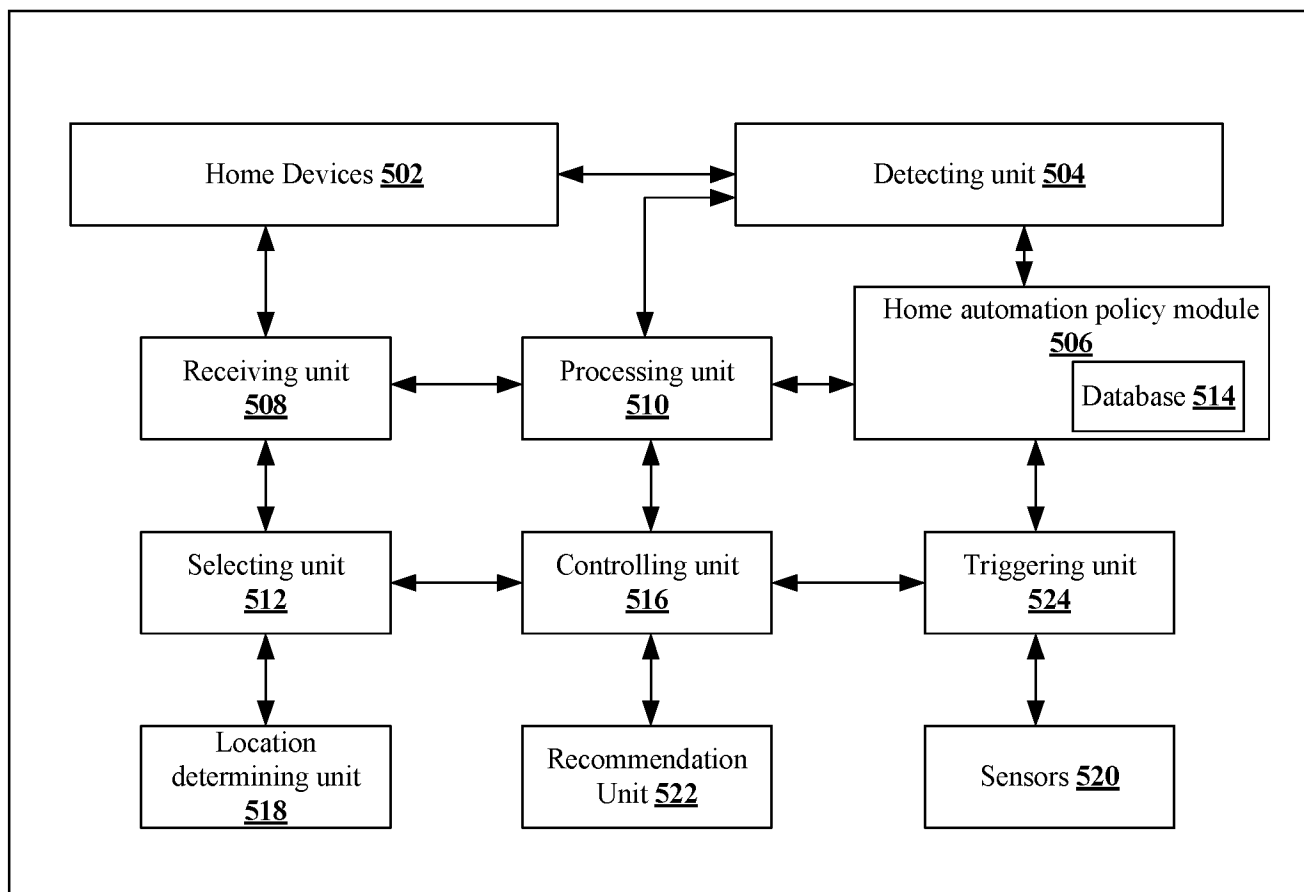



Figure 5

106 

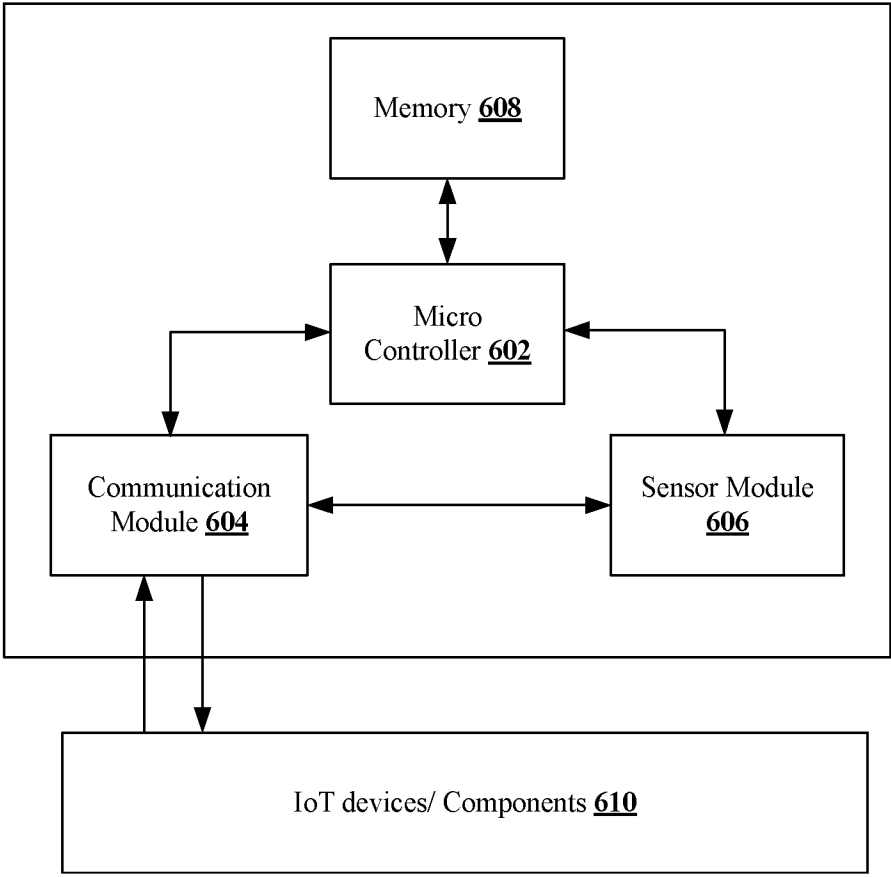


Figure 6

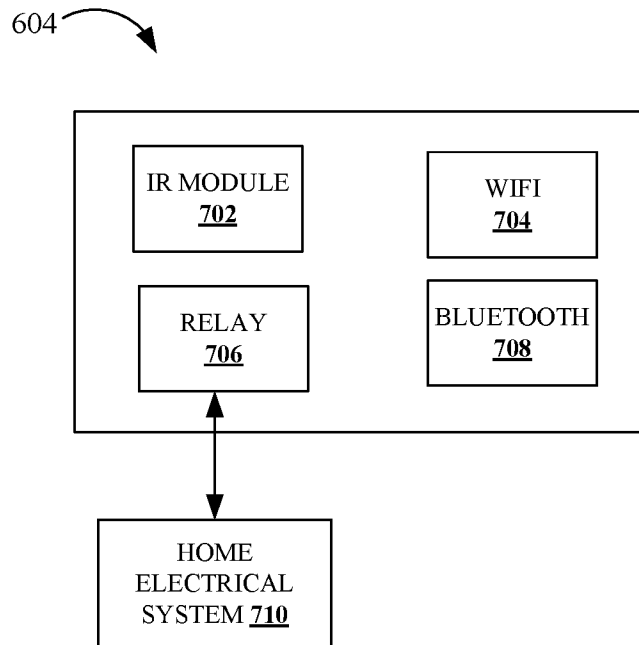


Figure 7

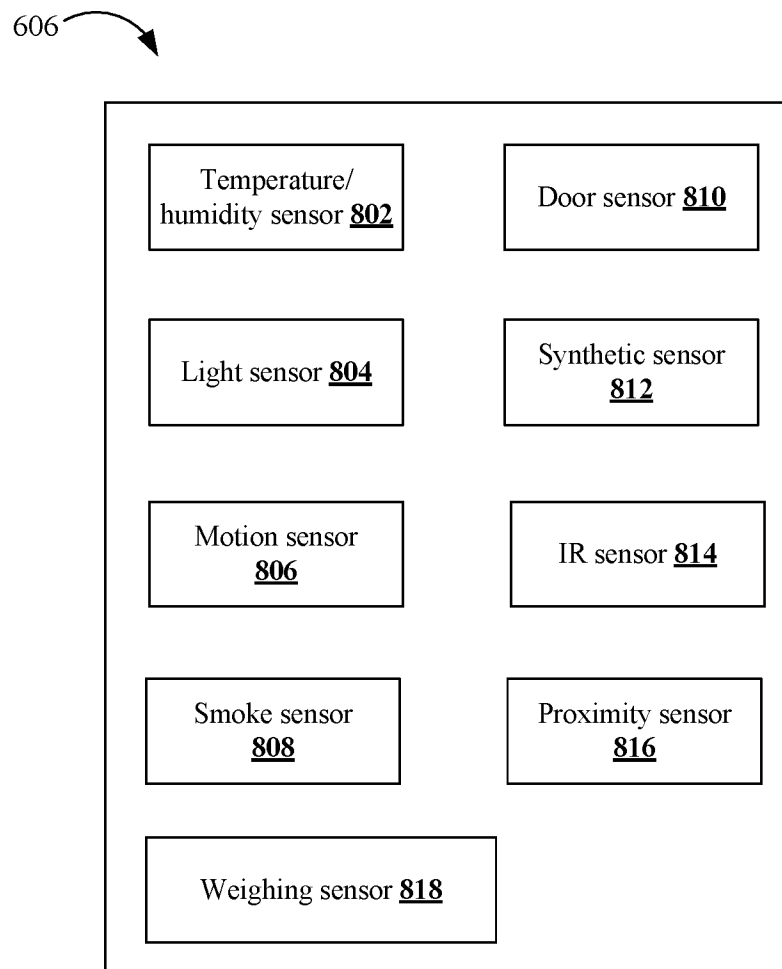


Figure 8

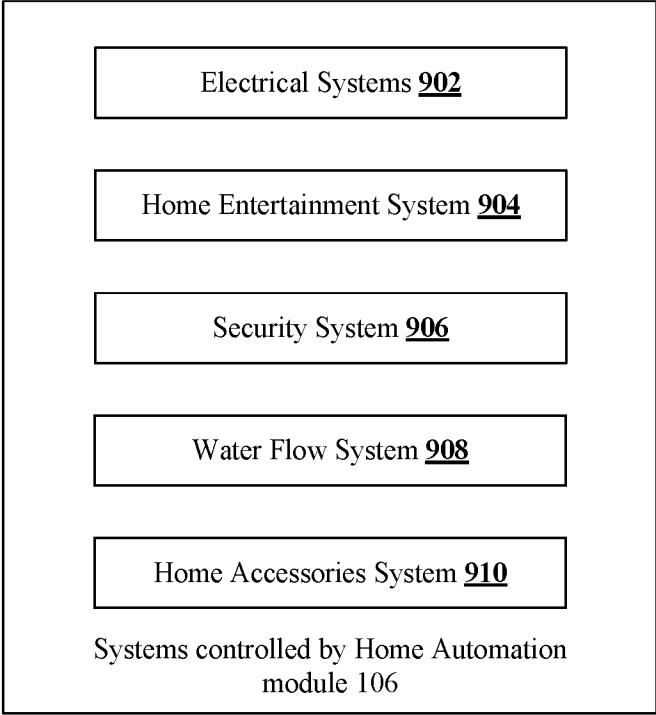


Figure 9

608

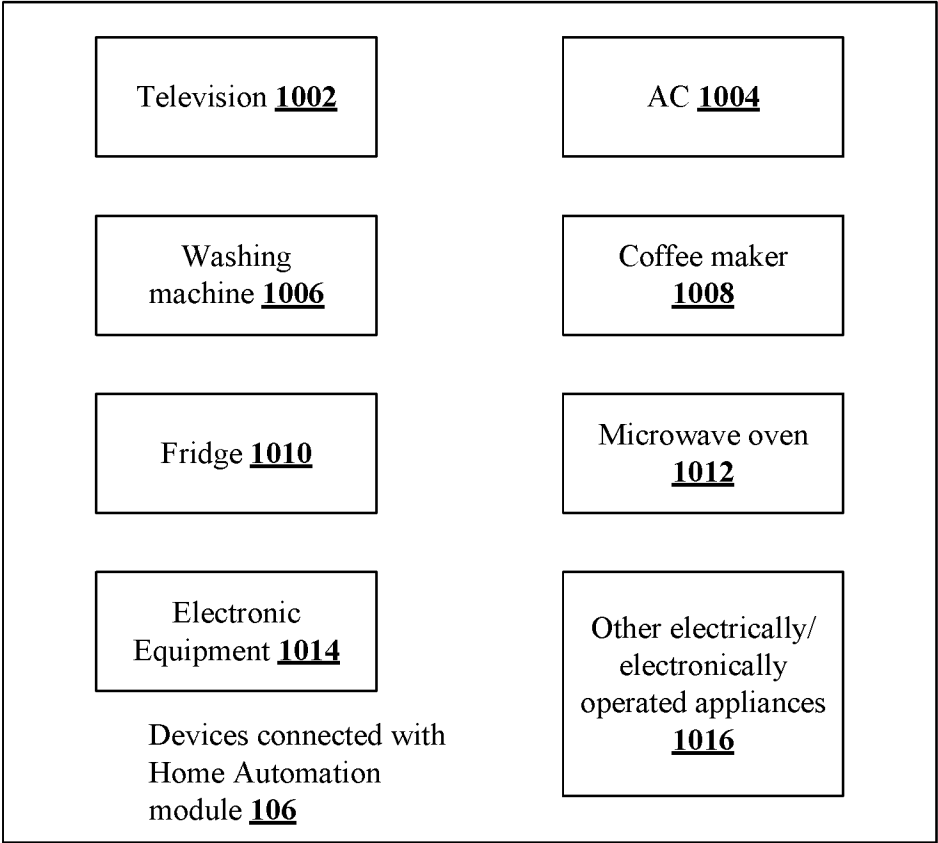


Figure 10

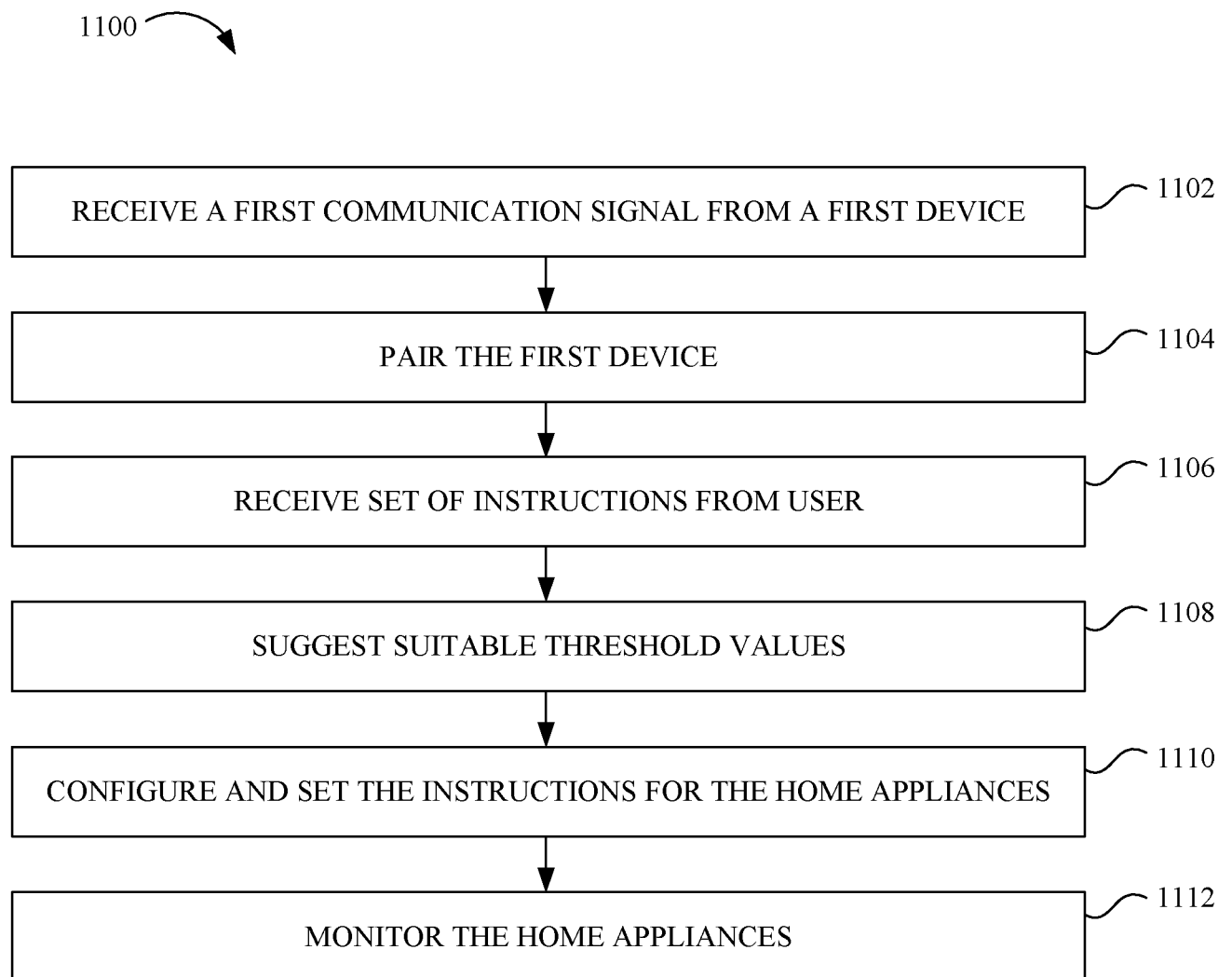


Figure 11

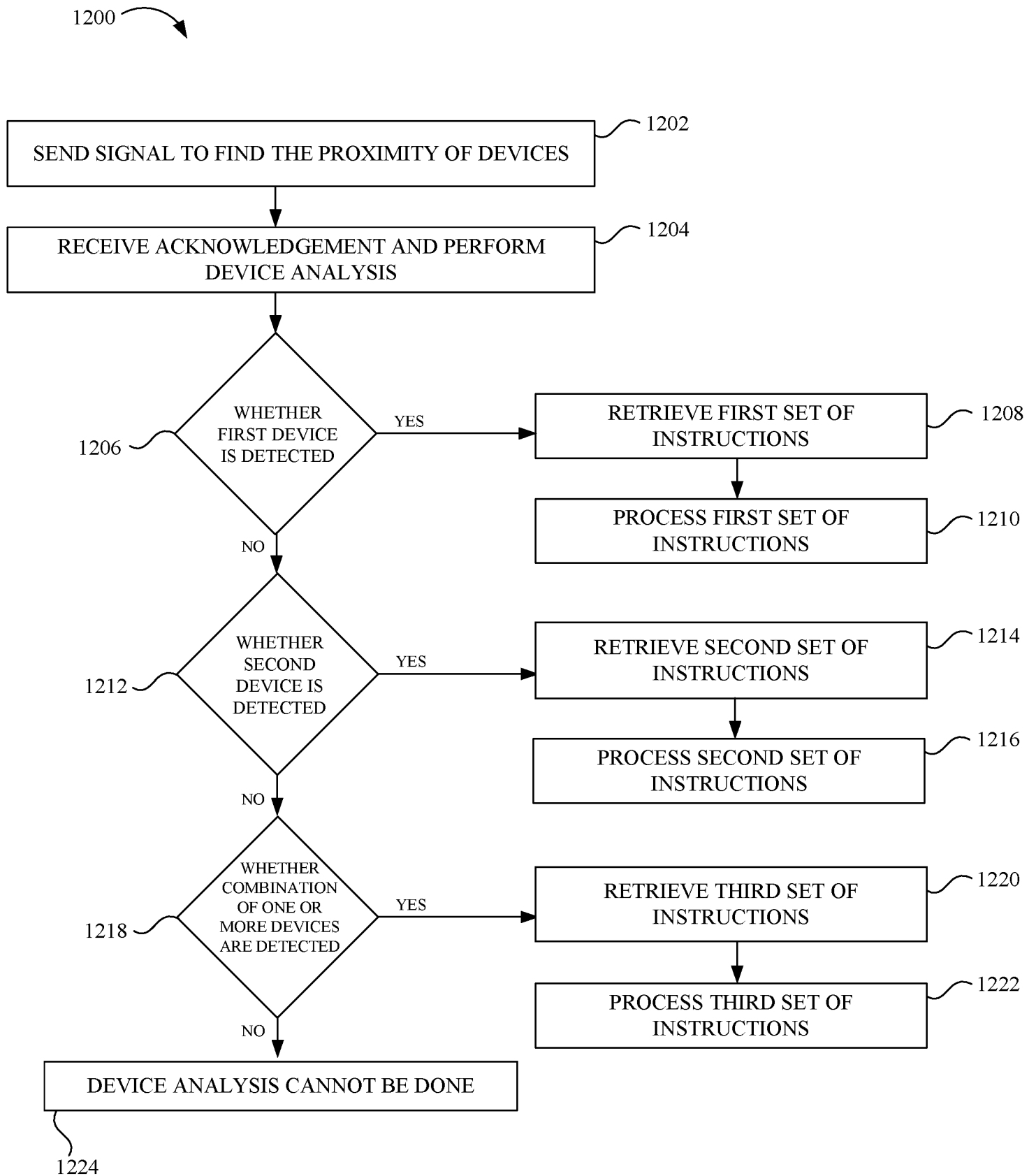


Figure 12

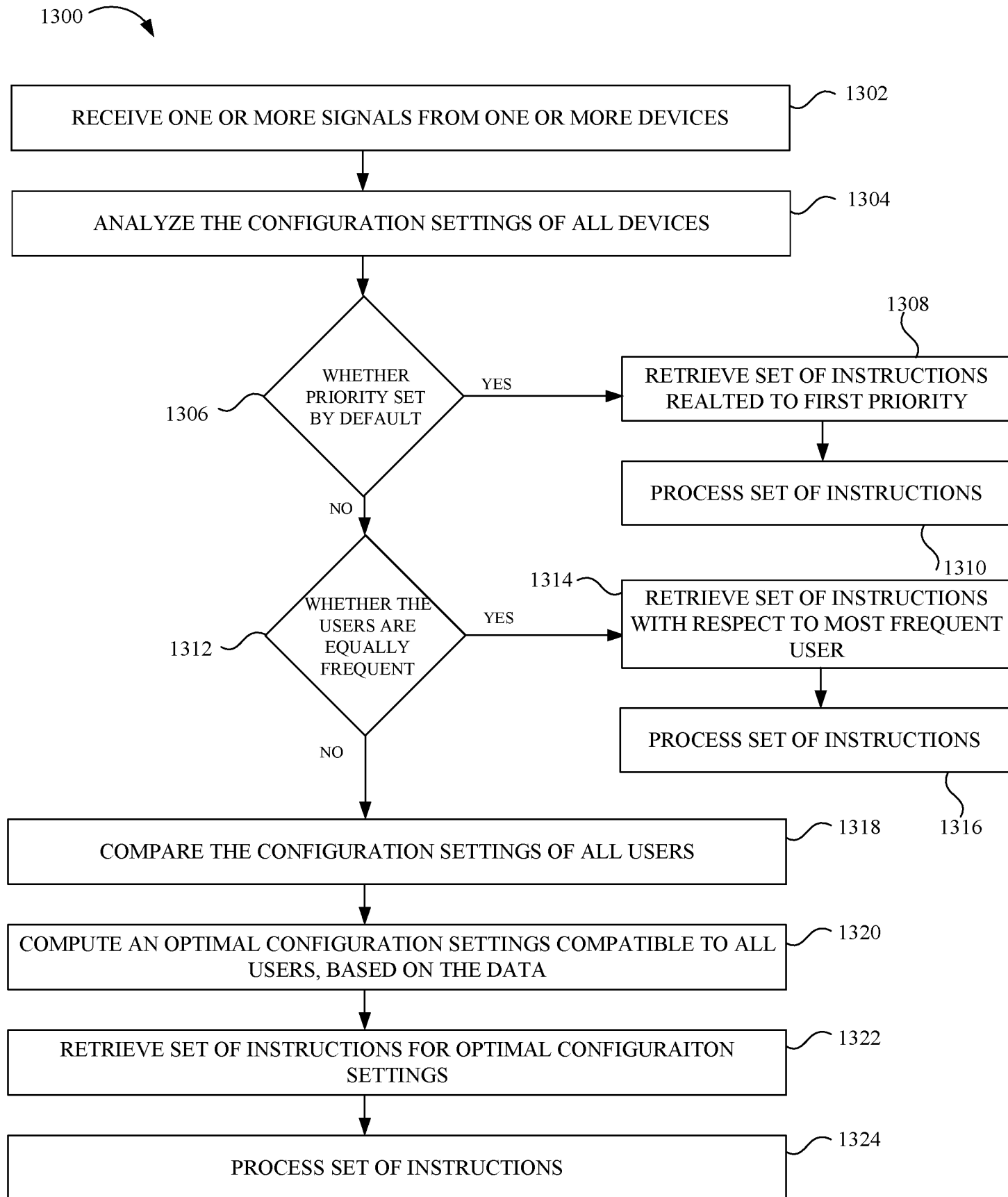


Figure 13

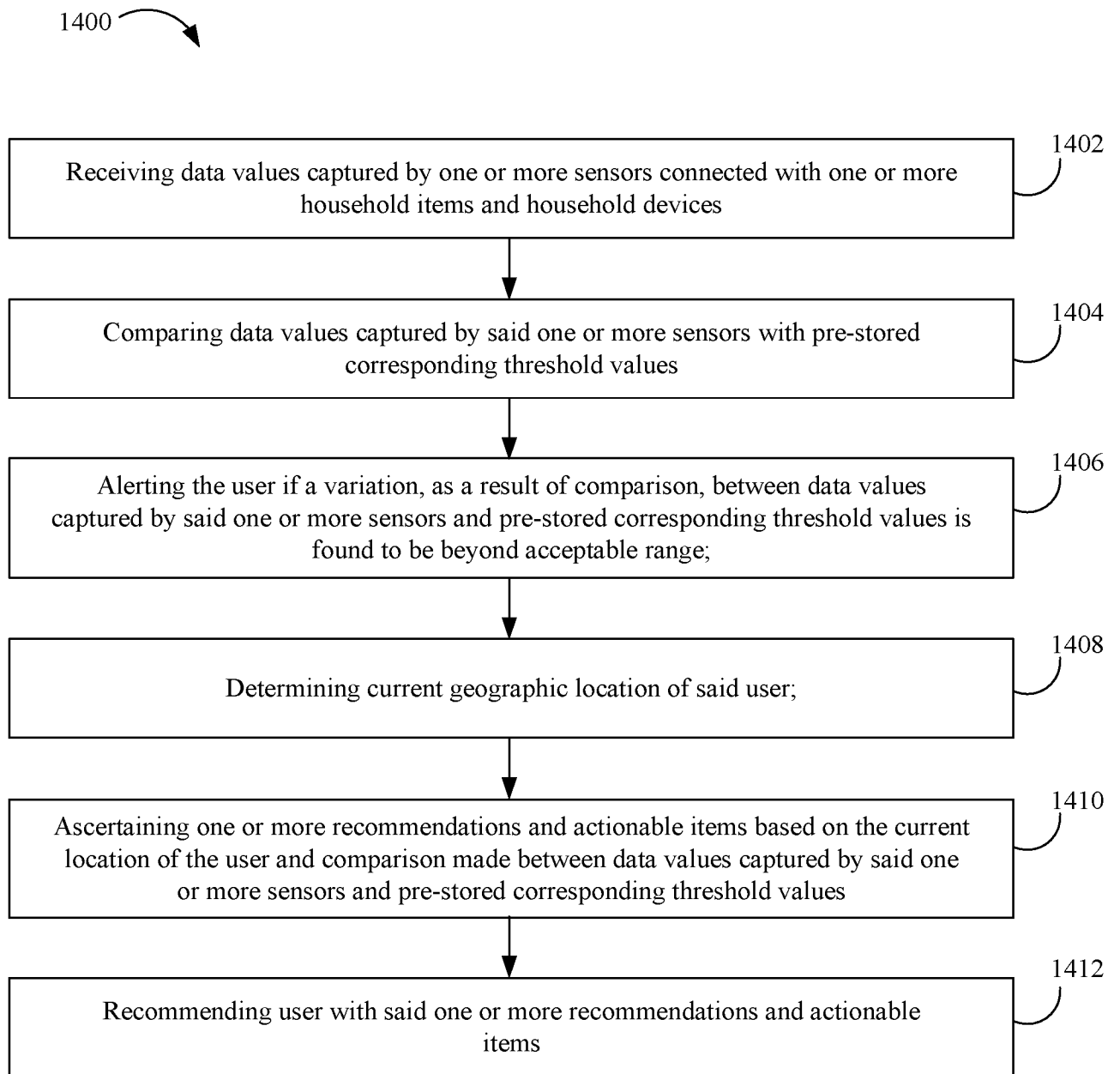
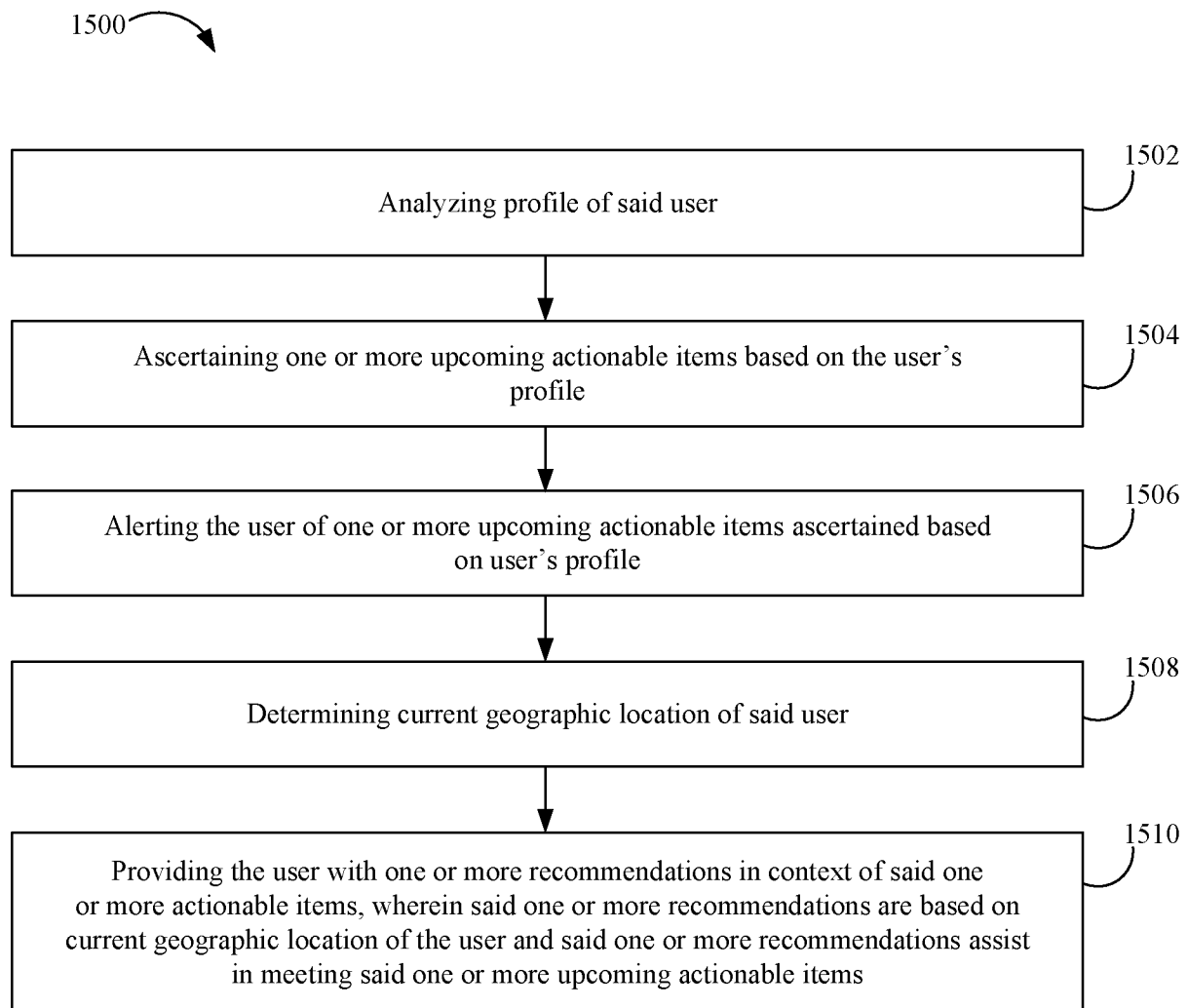


Figure 14

**Figure 15**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SG2019/050240

A. CLASSIFICATION OF SUBJECT MATTER

See Supplemental Box

According to International Patent Classification (IPC)

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G05B, H04L, H04W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

FamPat, IEEE, CNKI, Internet: home automation, 家庭自动化, smart home, 智能家居, home network, authenticate, verify, 验证, policy, rule, 规则, instruction, 政策, criteria, 准则, 标准, 策略, strategy, profile, select, choose, 选择, determine and related search terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CATANIA V. ET AL., User-Generated Services Composition in Smart Multi-User Environments. <i>Journal of Sensor and Actuator Networks</i> , 1 September 2017, pages 1-19 [Retrieved on 2019-08-02] <DOI: 10.3390/JSAN6030020> Figs. 1-2, 8, Abstract, Pages 2-3, 5-8, 12-13	1-20
X	US 2015/0019714 A1 (SHAASHUA T. M. ET AL.) 15 January 2015 Paras. [0032], [0034], [0057]-[0064], [0080]-[0092], [0099], [0138]-[0140]	1-20
X	US 2016/0259308 A1 (FADELL A. M. ET AL.) 8 September 2016 Paras. [0068], [0072], [0087], [0101], [0105]-[0118], [0152], [0175], [0257]	1-20

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

*Special categories of cited documents:

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"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

02/08/2019

(day/month/year)

Date of mailing of the international search report

13/08/2019

(day/month/year)

Name and mailing address of the ISA/SG



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INTERNATIONAL SEARCH REPORT

International application No.

PCT/SG2019/050240

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2014/0005809 A1 (FREI R. W. ET AL.) 2 January 2014 The whole document	-
A	CN 107819652 A (BEIJING XIAOMI MOBILE SOFTWARE) 20 March 2018 The whole document of the original non-English language document (a machine translation is enclosed only for your reference)	-

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SG2019/050240

Supplemental Box (Classification of Subject Matter)

Int. Cl.

G05B 15/02 (2006.01)

H04L 12/24 (2006.01)

H04L 12/28 (2006.01)

H04W 4/38 (2018.01)

G16Y 40/35 (2020.01)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SG2019/050240

Note: This Annex lists known patent family members relating to the patent documents cited in this International Search Report. This Authority is in no way liable for these particulars which are merely given for the purpose of information.

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